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Notes on the neotype of *Tuber taiyuanense*

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Abstract — The neotype of *Tuber taiyuanense* was re-examined and found to contain two different species. One of these corresponded with the protologue and is here designated as the neotype of *Tuber taiyuanense*; the other was identified as *T. liaotongense*.

Key words — *Ascomycota*, neotypification, truffle

Introduction

Tuber taiyuanense, the first record of the genus *Tuber* in China, was established by Liu (1985) based on a specimen from Taiyuan, Shanxi province. Unfortunately, the original type specimen was destroyed in a fire while the paper was being printed. Later, Wang & Pei (2001) selected a specimen collected from Beijing as the neotype for this species. Two clearly different descriptions, both citing the neotype, have since been published by Chen et al. (2005) and Song (2005). Chen et al. (2005) described the ascospores as "broadly ellipsoid", but Song described them as "long ellipsoid". We re-examined the neotype deposited in HMAS, Beijing, China (HMAS 75888) and found it contained two completely different species. One labeled HMAS 75888A has ellipsoid ascospores with spinose-reticulate ornamentation, while the other HMAS 75888B, contains sub-globose to broad ellipsoid ascospores with more or less regular reticulate ornamentation. From the two elements we have selected the one that corresponds with the protologue of *T. taiyuanense* and re-describe it and designate it as neotype here.

Methods

Macroscopic characters are described from the rehydrated dried specimens and microscopic characters from razor-blade sections mounted in 3% KOH (w/v), Melzer's reagent, or 0.1% (w/v) cotton blue in lactic acid.

For scanning electron microscopy (SEM), spores were scraped from the dried gleba onto doubled-sided tape, which was then mounted directly onto an SEM stub, coated with gold-palladium, and examined and photographed with a HITACHI S-4800 SEM. Measurements were made from 20 ascospores and asci for each specimen using material mounted in 3% KOH.

Taxonomy

From the original description: "Ascospores brown, 28.4–32.1 × 18.9–24.6 µm (4-spored), 37.8 × 26.5 µm (2-spored), spinose-reticulate, spines 3.8–4 µm long, hooked; reticulum 2.8–4.7 µm in diameter" and illustrations of *T. taiyuanense* by Liu (1985), the HMAS 75888A specimen (Figs. 1–3) is completely compatible with Liu's original type material, whereas HMAS 75888B (Fig. 4) is clearly different. We therefore designate the HMAS 75888A specimen as the neotype.

We identified the other specimen HMAS 75888B as *Tuber liaotongense*, a species endemic to China and common in northern China. Below we re-describe *T. taiyuanense* and *T. liaotongense* and provide illustrations of the HMAS 75888A and 75888B specimens.

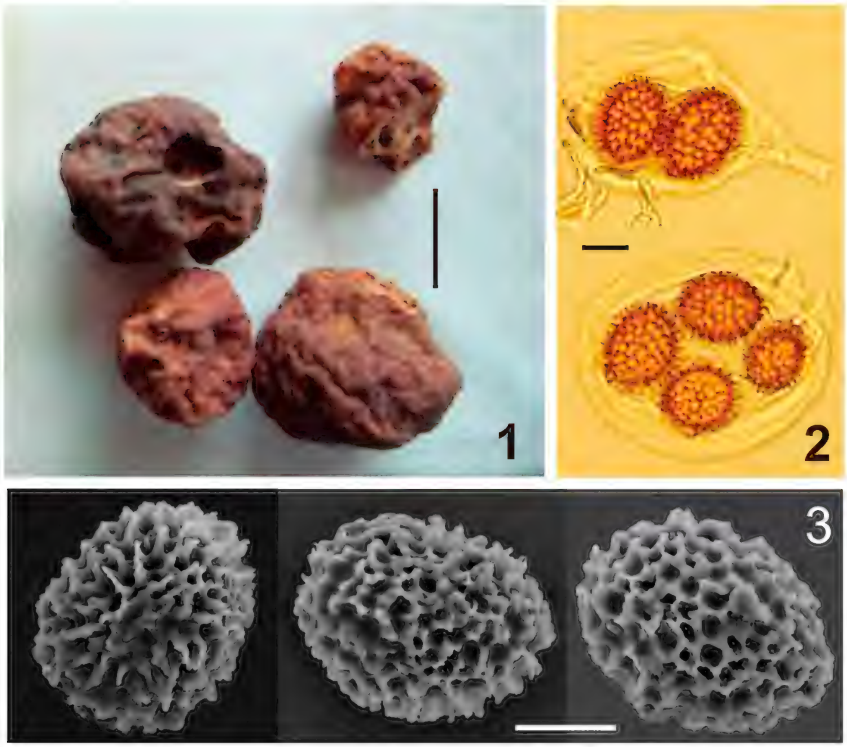
Tuber taiyuanense B. Liu, Acta Mycologica Sinica 4: 84 (1985). Figs.1–3

Type specimen examined: **CHINA. Beijing**, Dongling Mountains, in soil about 5 cm deep under pines, 20 Aug. 1998, H.A. Wen, X.Q. Zhang & Z. Wang 294 (HMAS 75888A, **neotype designated here**).

Ascomata globose to subglobose, sometimes irregularly lobed, 0.7–1.5 cm in diam., pale yellow, yellow brown or brown, the surface smooth, or sometimes with indistinct hairs in the furrows. Odor light when fresh. Peridium mostly 150–300 µm in thickness, composed of two layers. Outer layer pseudoparenchymatous, composed of subglobose or subangular cells, pale yellow or light brown, and up to 5–20 µm in diam.; hair-like hyphae sometimes arising from the outermost cell, 75–125 × 2.5–5 µm, hyaline, thin-walled, with blunt tips. Inner layer composed of intricately interwoven, hyaline hyphae up to 2.0–3.5 µm in diam. Gleba white when young, gray brown or pale brown at maturity, marbled with large and rare whitish or cream veins. Asci subglobose to globose, ellipsoid or irregular shaped, 50–90 × 35–70 µm, with a short stalk 7–25 × 5–12.5 µm, 1–4(–5) spored, irregularly arranged. Ascospores mostly ellipsoid, occasionally broad ellipsoid, yellow-brown at maturity, 20–45 × 18–30 µm excluding ornamentation, the ornamentation distinctly spinose-reticulate, with the spines 2.5–5 µm long, slightly curving at apex, and basally connected by an alveolate reticulum, the alveolae regular or irregular, 5–6 sided, mostly complete and closed, 2.5–5 µm in diam., 6–8 across the spore width.

Ecology, Distribution — Hypogeous, under *Pinus* spp. and *Quercus* spp. Known from Beijing, Hebei, Hubei, Shanxi and Sichuan in China.

Additional specimens examined: **CHINA. Beijing**, Dongling Mountains, under *Quercus mongolica* Fisch. ex Ledeb., alt. ca. 2100 m, 13 Sept. 2003, M.S. Song 091



Figs 1–3. *Tuber taiyuanense* (HMAS 75888A, neotype). 1. Ascocarps. Bar = 1 cm. 2. Ascospores observed under the light microscope. Bar = 20 μm. 3. Ascospores observed under the scanning electronic microscope. Bar = 20 μm.

(HMAS 97109); C.H. Dong 092 (HMAS 97139); B.H. Tang 093 (HMAS 97140). **Hebei province**, Xuanhua, 11 Oct. 1988, B.C. Zhang 517 (HMAS 60234, as *T. texense*). **Hubei province**, Shennongjia, under *Pinus* spp., alt. ca. 1700 m, Sept. 2003, G.Z. Zhao 095 (HMAS 97126). **Shanxi Province**, Yangcheng, Manghe, under *Quercus* spp., alt. ca. 620–640 m, 14 July 1990, M.C. Chang & Y. Ma 91037 (HMAS 88573); Yuncheng, Qijiahe forest farm, under *Quercus* spp., alt. ca. 880 m, 18 Aug. 1990, B. Qiao 91060 (HMAS 88595). **Sichuan province**, Wenchuan, Wolong national nature reserve, 22 Sept. 1989, B.C. Zhang 622 (HMAS 60241B); B.C. Zhang 616 (HMAS 60238); B.C. Zhang 619 (HMAS 60240).

Tuber liaotongense Y. Wang, Atti del II Congresso Internazionale sul Tartufo, Spoleto: 46 (1988). Fig.4

Ascomata globose to subglobose, sometimes irregularly lobed, with shallow to deep furrows, 0.4–1.8 cm in diam., pale yellow brown to brown, the surface smooth, or usually with indistinct hairs in the furrows. Odor light when fresh. Peridium mostly 150–250 μm in thickness, composed of two layers. Outer

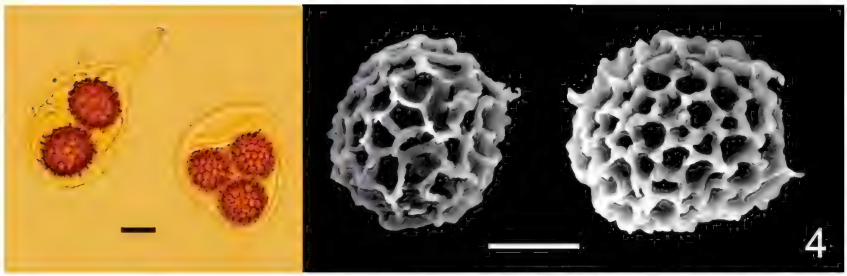


Fig. 4. *Tuber liaotongense* (HMAS 75888B). Ascospores observed under the light microscope (Bar = 20 μm) and the scanning electronic microscope (Bar = 10 μm).

layer pseudoparenchymatous, composed of subglobose or subangular cells, pale yellow or light brown, and up to 6–15 μm in diam.; hair-like hyphae sometimes arising from the outermost cell, 20–80 × 2.5–5 μm, hyaline, thin-walled, with blunt tips. Inner layer composed of intricately interwoven, hyaline hyphae up to 2.5–5 μm in diam. Gleba white when young, pale yellow brown, brown or deep brown at maturity, marbled with large and rare whitish or cream veins. Asci subglobose, ellipsoid or irregular shaped, 50–90 × 30–70 μm, with a short stalk 9–25 × 4–10 μm, 1–4(–5) spored, irregularly arranged. Ascospores subglobose to broad ellipsoid, yellow-brown at maturity, 22–40 × 20–35 μm excluding ornamentation, the ornamentation spinose-reticulate, 2.3–3.5 μm high, spines short, usually higher than reticulum a little, making the ornamentation look like a typical reticulum, the alveolae regular, 5–6 sided, mostly complete and closed, 3.5–5(–8.5) μm in diam., (4–) 5–6(–7) across the spore width.

Specimen examined: **CHINA. Beijing**, Dongling Mountains, in soil about 5 cm deep under pines, 20 Aug. 1998, H.A. Wen, X.Q. Zhang & Z. Wang 294 (HMAS 75888B).

Comments — Our study of the specimens deposited in various herbariums suggests that *T. taiyuanense* is common in northern China. It can be recognized by the small, more or less brown colored ascocarps and the typical spinose-reticulate ascospores. In contrast, the similar species *T. huidongense* Y. Wang and *T. umbilicatum* Juan Chen & P.G. Liu, both originate from southwestern China. *Tuber huidongense* can be easily differentiated from *T. taiyuanense* by the alveolae and ascospore size, which are important characteristics for both the phylogeny and taxonomy of *Tuber* (Cao 2010). The alveolae in *T. huidongense* are 3–5(–8.5) μm in diam and 3–6 across the spore width, are larger than in *T. taiyuanense* (2.5–5 μm in diam and 6–8 across the spore width). *Tuber umbilicatum* has ascospores similar to *T. taiyuanense* but is clearly differentiated by its umbilicate ascocarp. In addition, *T. huidongense* is common and *T. umbilicatum* is not uncommon in southwestern China, whereas *T. taiyuanense* has yet to be found there.

Tuber liaotongense, described from Liaoning Province (Wang 1988), is also very common in China and shares the same distribution area as *T. taiyuanense*. Almost all species that have spiny or spinose-reticulate ornamentation on the spores have ellipsoid spores. The exception is *T. liaotongense*, which has subglobose spores. In addition, the spines on *T. liaotongense* spores are so low that it is difficult to see them even under high power on an optical microscope, although they can be clearly seen by SEM photomicrograph (Fig. 4). Molecular data has also confirmed *T. liaotongense* to be in the Rufum Group (Song 2005).

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